DEPARTMENT OF THE INTERIOR .

Open-File Report OF 85-352

RELATIVE SUSCEPTIBILITY TO LANDSLIDING EXPLANATION OF MAP SYMBOLS

- None to slight. Area of non-existent to low susceptibility to landsliding. Stable under most natural conditions. Includes infrequent
- to occasional stream bank slumping too small to show at 1:24,000.

 [2] Slight to moderate. Area of low to medium susceptibility to landsliding. Includes sparse numbers of small recently active landslides. Locally abundant incidence of landslides usually

attributable to artificial slope modification. Most widespread unit on

- Moderate to severe. Area of medium to high susceptibility to landsliding. Generally includes large numbers of recently active landslides and/or well-defined indications of old (mostly prehistoric)
- 4 Severe. Area of highest susceptibility to landsliding. High density of recently active (and commonly large) landslides. Well-defined old (mostly prehistoric) landslide terrane.
- XXX Rockfall hazard

Introduction

This map is the second in a series of maps based on a field study of landslides in the Marietta, Ohio, area. A map showing recently active landslides has been released (Pomeroy, 1984b). The area includes most of the Marietta 7 1/2-minute quadrangle and parts of the Belmont, Willow Island, Valley Mills, Fleming, and Parkersburg 7 1/2-minute quadrangles, and is located within the Appalachian Plateaus physiographic province.

The Marietta area on the southwestern side of the Dunkard basin shows a high incidence of landslides typical of the southeastern Ohio - western West Virginia - southwestern Pennsylvania region. Relief is generally 300 to 400 feet, markedly less than that in other areas of the Dunkard basin which have an average relief of 500 to 600 feet.

The Marietta area was investigated in the springs of 1983 and 1984 and in the fall of 1983 to obtain data on the topographic and geologic setting of its landslides (Pomeroy, 1984a). Field data were obtained by making closely-spaced traverses over a period of approximately 75 to 80 days.

Relation of geology and precipitation to landsliding

A thick sequence of subhorizontal red shale and mudstone interbedded with intermittent thin to thick sandstone beds belonging to the Monongahela and Dunkard Groups of Pennsylvanian and Permian age is conducive to the development of landslides. In the Marietta area earthflows, slumps, debris slides, and complex slope movement forms (Varnes, 1978) take place within the overlying mantle of weathered rock and soil.

Lithologic and geomorphic factors play an important role in the origin and distribution of slope failures. Ground-water seeps are common at contacts between permeable cliff-forming sandstone and underlying less permeable, poorly-exposed shale and mudstone that form more moderate slopes. Movements in the weathered rock and soil originate below the seeps along slopes of low permeability.

Most recent movements in the Marietta area have been caused by natural events such as precipitation (Pomeroy, 1984b) rather than by construction and other artificial slope modifications. Of course, land modifications can initiate landsliding even where recent landslides are absent (and increase the problem where slides are present).

Criteria used in construction of map

Although slope movements are widespread within the study area, certain areas are more sensitive than others because of factors such as slope angle, lithology of underlying bedrock, poor natural drainage, and slope modification. This map distinguishes areas that have different potentials for landsliding by ranking the relative stability of the slopes. The map (see also table 1) indicates where new landsliding can be expected to take place.

Ranking of the slopes is based primarily on field inspection, which enabled the author to set up a classification of slopes based on degrees of susceptibility (see table 1).

Criteria used in differentiating the various areas are based mainly on the relative abundance of competent and incompetent rock, density of recent (historic) slope movements, identifiability of old slope movements, and surface drainage factors. The various criteria cited above are roughly equal in importance. Boundaries range from sharp to gradational. Finally, integrating a study of aerial photographs with the ground traverses was helpful.

For example, the forested slopes near Reno in the extreme southeastern corner of the map area have been designated as "3" or "4". These slopes show a high density of recent slope movements (about 90 within a 4.5 km² area), coalescing old slope movements, shale/mudstone more abundant than sandstone/siltstone, and fair to poor surface drainage. In contrast are the largely forested slopes north of Ohio 26 and east of Brush Run in the eastern part of the map area which have been designated as "2". This area shows few recent and old slope movements, sandstone/siltstone more abundant than shale/mudstone, and well-defined surface drainage.

The difference between "3" and "4" slopes is slight and relates generally to the density of recent movements and surface drainage. Slopes designated as "4" are made up of recognizable coalescing old slope movements.

All slopes in the Marietta area are subject to extremely slow movements such as creep. Where creep becomes accelerated either by natural events or by man-created activities, landsliding commonly results. Detailed geotechnical investigations of specific sites are recommended for extensive slope modifications.

References Cited

Pomeroy, J. S., 1984a, Slope-failure hazards in the Marietta area, Washington County, southeastern Ohio: Geological Society of America Abstracts with Programs, 1984, Southeastern and North-Central Section meeting, v. 16, no. 3, p. 187.

Pomeroy, J. S., 1984b, Preliminary map showing recently active landslides in the Marietta area, Washington County, southeastern Ohio: U.S. Geological Survey Open-File Report 85-4, 1:24,000-scale map with text.

Varnes, D. J., 1978, Slope movement types and processes, Chapter 2 in Schuster, R. L., and Krizek, R. J., eds., Landslides -- analysis and control: National Research Council, Highway Research Board Special Report

176, p. 11-33.

TABLE 1. CHARACTERISTICS OF MAP UNITS Relative susceptibility None to slight Slight to moderate Moderate to severe to landsliding (map unit 1) (map unit 3) (map unit 4) Topographic Alluvial floodplains and Slopes variable in grade; Slopes variable in grade; Slopes variable in grade; terraces of valley floors commonly gentle to moderate commonly moderate to commonly moderate to along Ohio River and and less frequently steep tributaries; relatively flat upland areas mainly west of Muskingum River Gravel, sand, silt, and clay Competent rock (sandstone or Variable amounts of Variable amounts of competent in valleys; hilltops siltstone) about equal to or competent and incompetent and incompetent rock but commonly underlain by sand- slightly greater than rock but latter (shale or latter (shale/mudstone) is stone or siltstone; less incompetent rock (shale or mudstone) is more abundant usually more abundant commonly by shale or mudstone mudstone) in most places Generally good; well-defined Variable. Good to poor Generally poor because of land good to excellent slope drainage common (see comment in column 4) surface changes caused by landsliding. Small ponded Multidirectional Preference for NW, N, NE, Preference for NW, N, NE, and E orientations except and E orientations away along Ohio River except along Ohio River Relative density Scattered but generally Generally make up at Make up at least 10 percent of recent (historic) least 3 percent of each sparse. Make up less than 3 and up to 100 percent of each slope movements percent of each delineated delineated area. A few delineated area. Each landslide areas do not show recently commonly within 300 ft of another active landslides Recognition of old Generally poorly defined Easily recognizable; Mostly recognizable and well-(prehistoric) slope defined; delineated area is made locally well-defined; movements delineated area may up of coalescing old (prehistoric) contain coalescing old landslides landslides Type of slope Minor slumping along stream Shallow earthflows dominant; Shallow earthflows Shallow earthflows dominant: channels; largely also debris slides, slumps, dominant; also debris also creep, debris slides, slumps, (Varnes, 1978) unpredictable as to siting combinations, creep and slides, slumps, and combinations; some deep-seated rockfall. combinations; creep and movement. rockfall. Some deepseated movement probable Limitations None for upland areas: Variable. Uplands pose few Generally difficult to Difficult to develop under any bottomlands are prone to problems. Some slopes may need develop; geotechnical circumstances. Geotechnical development flooding geotechnical investigation. investigation is necessary investigation is necessary must. Slope modification such as Slopes best kept as "greenbelt" surcharging natural slope (in natural state) with fill may trigger movement Probability of None to slight except for Scattered occurrences. Most Moderate to high density High density especially future slove areas of stream bank landslides would be less than especially adjacent to adjacent to existing slides. movement under slumping 100 ft in maximum dimension existing slides. Heads Heads and/or other parts of natural conditions and/or other parts of recently active landslides might (rainfall) recently active landslides be reactivated. might be reactivated Examples of Marietta, central part; Slopes adjacent to Colegate Slopes bordering Ohio 821 Slope on north side of Greene St. areas designated Devola; Oak Grove; uplands Road. Locally high incidence of above Second Creek. Slope east of Marietta College. Slopes west of Harmar and Oak Grove minor movements along on west side of Muskingum facing Ohio River southeast of artificially modified slopes River north of Washington Reno. Slopes on southwest side of St. bridge and south of Duck Creek near Stanleyville. at hospital northeast of

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

PRELIMINARY SLOPE STABILITY MAP SHOWING RELATIVE SUSCEPTIBILITY TO

Colegate Road and at apartment Oak Grove

development west of Colegate

Road. Slopes above Devol and Bucks Runs west of Muskingum River

LANDSLIDING THE MARIETTA AREA, WASHINGTON COUNTY, SOUTHEASTERN OHIO

Slope east of Ohio 60 east and

southeast of Devola

by John S. Pomeroy

1985

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.